Copper Naphthenate –

An Update On New Trends And Changes In The Last Decade

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ABSTRACT

Over the last 100 years, copper naphthenate has had a varied use pattern. For the last decade and a half, it's predominate use has been as a heavy-duty industrial wood preservative for the pressure treatment of wood poles. Since 1988, over 1.2 million wood poles have been pressure treated with copper naphthenate. With southern pine poles, there were about 4800 (0.5%) early failures of poles treated before 1994. Since then, no significant failures are known in southern pine poles and there have never been any reports of early failures in Douglas fir poles. Today's copper naphthenate is substantially different than the product used in the introductory phases. This paper will outline these differences and discuss the safeguards in place to prevent early failures from occurring today.

Keywords: copper naphthenate, efficacy, emulsions, failures, poles, preservative

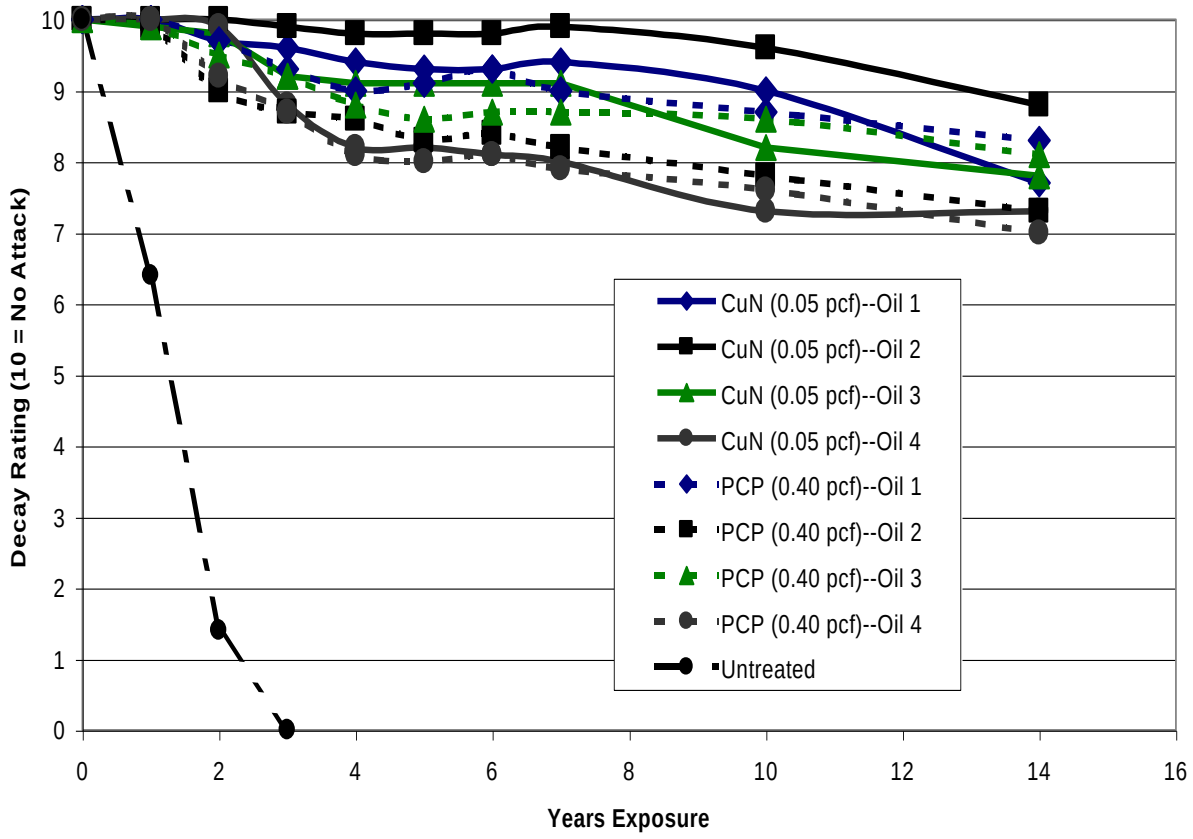
INTRODUCTION

Although no preservative manufacturer likes to admit it, every preservative system and its respective formulations have treating idiosyncrasies and problems. Sometimes the preservative itself is repeatedly shown to be effective but problems occur due to factors unknown at the time of treatment. As the problems surface, appropriate changes are made to the standards governing the preservative or treatment to eliminate any future occurrence. Such is the case with copper naphthenate.

No allegation has ever been made that copper naphthenate is itself an ineffective preservative. On the contrary, numerous field tests by a number of researchers[1] have documented the simple fact that copper naphthenate performs and that poles properly treated with copper naphthenate will meet the industry life expectancy of 35+ years. In fact, a report[2] involving over 750,000 poles showed 70-80% of preservative treated poles can last 50-60 years given a proper inspection and remedial treatment program.

Recently, an EPRI sponsored test program showed the 14-year performance of copper naphthenate at 0.05 pcf retention to be equivalent to 0.40 pcf pentachlorophenol in two different Mississippi locations with two different soil types with four different oil carriers[3]. The decay data from the highest AWPA hazard zone (i.e. the south Mississippi site) documents this excellent performance (Figure 1). The decay hazard at the two Mississippi sites cannot be overemphasized: untreated stakes typically fail in 3 years at the southern site (as they did in this test) while even untreated poles fail in 4-5 years at the central site. This is a very harsh test.

Figure 1. EPRI TESTS IN SOUTH MISSISSIPPI



Nonetheless, there have been premature failures with southern pine poles treated in the late 1980's through the early 1990's with copper naphthenate formulations and some of these resulted in litigation. Many of the lawsuits were settled out of court with the details remaining confidential and not available to the public. It is very clear though that the numbers of poles involved in the litigation vastly overestimates the true number of defective poles which is estimated at about 4800 poles. It should also be emphasized that no failures are known in any other species and few, if any, southern pine failures occur with poles treated after 1994.

It is unfortunate that problems occur but numerous steps have been taken to avoid future premature failures with copper naphthenate. In many cases the precautions involve revision of existing AWPA preservative or commodity standards. In others, operating procedures were revised to address specific issues. The end result is that today's copper naphthenate pole is produced under significantly different guidelines and specifications and these safeguards are discussed further.

DISCUSSION

To better understand the issues, chemical companies have interviewed utility companies, treaters, inspection companies, pole sellers, and industry experts. What has been learned is that each case involves different issues since different situations existed at different times. Thus, at different times, one or more of the following conditions has been cited as problem causing and each of the cited conditions and its subsequent safeguard are discussed below.

Pretreatment and Incipient Decay

Although the potential for incipient decay exists with all pole preservatives since it is a function of the inspection and treatment process, the best method to prevent incipient decay from spreading throughout the pole is to heat sterilize the pole. Since the mid-1990's, all southern pine copper naphthenate poles have been kiln-dried before treatment using schedules which effectively kill all decay organisms. Thus the potential for incipient decay problems in today's copper naphthenate is negligible.

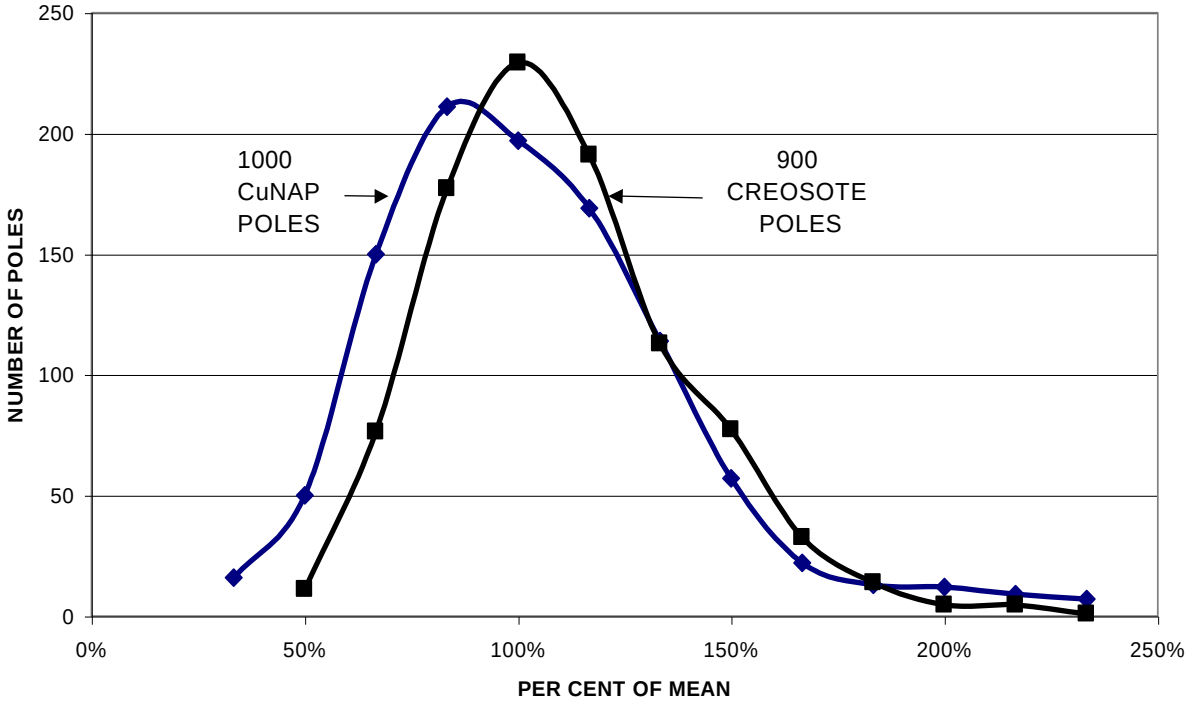
Improper Sterilization/Conditioning/Drying

As noted above, today's copper naphthenate poles are properly dried to low moisture contents. Since it was found that deep copper naphthenate treatment (i.e. good penetration) for southern pine is obtained at these low moisture contents, treater quality assurance procedures have been revised to ensure good drying. Current preservative manufacturers are aware of this need as well and can educate future treaters. In short, today's and tomorrow's copper naphthenate poles will be dried and sterilized properly so that the preservative can penetrate throughout the sapwood.

Inadequate Retention Distribution

Although low (sub-threshold) retention treatment was suspected, examination of the retentions for 1000 copper naphthenate poles compared to 900 creosote poles showed no significant differences (Figure 2)[4]. Both preservatives had reasonably Gaussian distributions and one concludes that the retention distributions between copper naphthenate and creosote are the same. Other work has shown that creosote and pentachlorophenol in oil have the same retention distributions[5] so it is reasonable to conclude that copper naphthenate does not differ from other oilbornes in its retention profile.

Figure 2. RETENTION DISTRIBUTIONS



Inspection Deficiencies

Poor inspection techniques can result in poorly performing material regardless of the preservative system used. In short, NO preservative can overcome the problems inherent in bad inspection and problems of this sort have been reported with all preservatives. Now the inspection of copper naphthenate poles is extremely vigilant and often it exceeds that of other preservatives due to procedural changes at inspection agencies and treating plants. As just one example of the enhanced quality assurance procedures, southern pine poles treated with copper naphthenate poles are 100% inspected regardless of size.

Retention Selection

As with other oilbornes, different retentions of copper naphthenate poles are specified for different hazard zones. Use of the proper retention of any preservative for the respective AWPA hazard zone gives the consumer the long lasting pole he desires. For copper naphthenate, increased educational tools and numerous presentations in the past several years have steadily emphasized this aspect. This increased awareness against the inadvertent use of low retention levels in high AWPA hazard zones provides a safeguard not only for copper naphthenate but also for all preservatives.

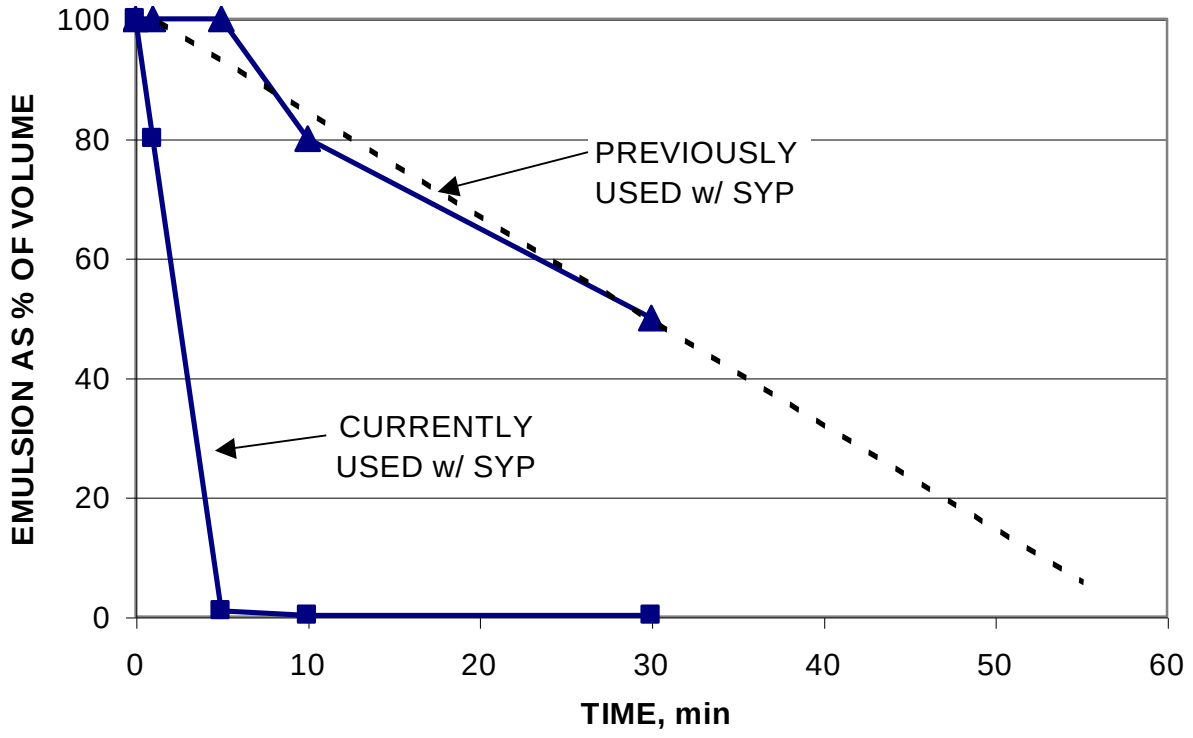
Treating Solution Water Content

If any oilborne treating solution has high water content or contains emulsions, the possibility exists that the water phase will penetrate into the wood pole while the oil-phase coats the pole exterior. This causes a "greenhouse-like" effect of having a high moisture content in the interior of the pole, even if it was effectively dried, while the exterior surface is water repellent which retards drying and keeps the pole interior moisture content elevated. For copper naphthenate, any problems of this sort are effectively negated by closely monitoring the solution moisture content, removing any excess water from the solution by distillation and/or separation and using formulations that are easily separable from water. All of these steps are being done today and inspection agencies are also paying close attention to the moisture content of copper naphthenate treating solution.

Emulsion Problems

The formation of stable water emulsions in copper naphthenate formulations was said to prevent effective treating. As shown below, any propensity for this problem has been addressed in that today's copper naphthenate effectively and completely separates from water in a very short time (5 minutes). It should also be noted that this test was run with water rich in extractives from Southern pine and these extractives have been shown to severely exacerbate separation problems[6].

Figure 3. SEPARATION TIMES OF CuN IN SYP EXTRACTIVE RICH WATER



Synthetic Acids

Earlier AWPA papers have suggested that non-naphthenic or synthetic acids are used in many copper naphthenate formulations[7,8]. It should be noted that many of the formulations tested by these authors are for retail distribution as over-the-counter products for home use and AWPA pressure treatment specifications do not apply to these formulations. However to address this issue for pressure treatment formulations, AWPA Standard P8 for copper naphthenate was revised to preclude the use of any non-naphthenic or synthetic acid. Recently, a new analytical technique was published to verify the use of natural naphthenic acids[9]. Now, specifying that copper naphthenate must conform to P8 prevents the use of non-naphthenic materials in pole treatment formulations and this can be easily verified by analysis. As further assurance, preservative manufacturers certify that no synthetic acids were used in the production of each batch of copper naphthenate.

Chemical Manufacturing Methods

Three different manufacturing methods have been used for copper naphthenate. Without going into the respective chemistries, these can be referred to as the Fusion Process, the Double Decomposition Process and the Direct Metal Process. There are advantages and drawbacks to each of these but the procedure used for today's copper naphthenate yields the lowest amount of byproducts (solids, impurities, etc.). This means that any problems due to these materials are minimized. It should also be noted that all material is filtered to remove any solids and the quality assurance program has rigid specifications for product consistency.

Supplier Support

The current supplier of copper naphthenate has a deep knowledge base about all aspects of copper naphthenate chemistry and is thoroughly committed to the copper naphthenate treatment of poles of any species. This commitment is demonstrated by their in-house publications (print, cd-rom, webpage), their support of the wood treating industry and their registered use of ISO 9002 manufacturing procedures to ensure the highest product consistency. Treating plants have been provided with effective, knowledgeable procedures and all treating plant issues are addressed either in-house or by calling on outside consultants as necessary. This level of support to a single preservative system matches that of any other preservative used today.

Treater Knowledge

Understandably, the depth of treater knowledge about the "behavior" of a preservative increases over time. The current treater of Southern pine poles has been using copper naphthenate for over a decade. In that time the copper naphthenate quality assurance techniques have been refined and documented and numerous plant personnel have been trained. This increased knowledge base results in high quality southern pine poles being produced today.

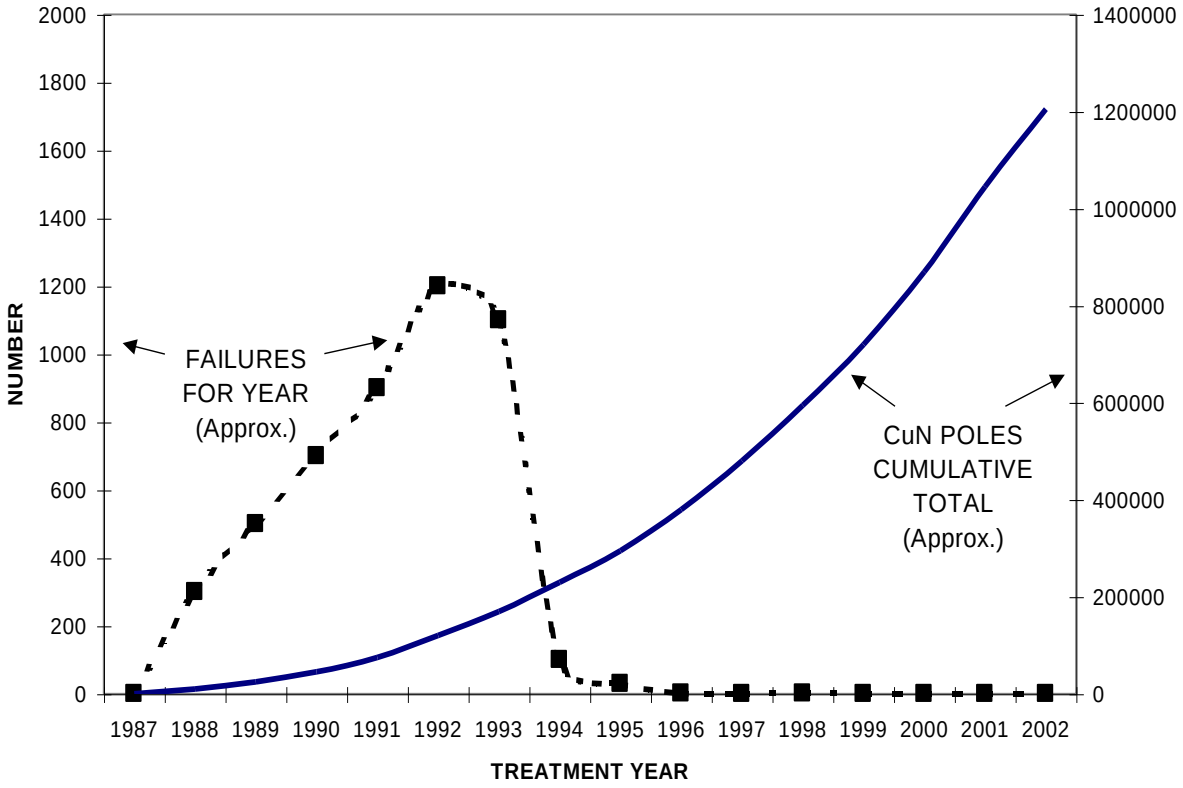
RESULTS

Over 1.2 million poles have been treated with copper naphthenate and less than 5000 have had early decay problems. By itself, this failure rate (< 0.5%) is certainly less than one might expect based on a normal distribution curve for wood poles with a mean service life of 35 years. A similar perspective is supplied by the results of a nationwide inspection of copper naphthenate poles treated from 1988 to 1999[10]. This survey included poles in all hazard zones that had been installed by twelve different utilities and treated by eight different treaters. In all, 307 poles were sounded and bored and only 2 poles—both from the 1990-1994 era—had early decay.

More importantly, numerous changes have been instituted to address all suspected causes of early failures in Southern pine poles. These cumulative changes have resulted in no significant failures in copper naphthenate treated Southern pine poles produced since 1994 (Figure 4).

Since there was a 3-4 year time lag between treatment and the start of failures, sufficient time has passed that we can safely conclude that poles treated since the mid-1990's do not and should not have any significant failure history. The enhanced procedures, revised specifications, redundant safeguards and increased awareness of all parties involved have combined to provide the utility industry with the product they desire: a high quality, long-lasting, well-treated wooden pole.

Figure 4. CuN TOTALS



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